

# Introductory Guide to Value Planning

July 2019

# ACKNOWLEDGMENTS

The System Improvement Team (Sync), a collaborative effort by the Public Works Board and the departments of Commerce, Ecology, and Health, developed this Value Planning Guide. The team’s charter is to identify, implement, and report to the Washington state legislature about infrastructure improvements.



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## Who Needs Value Planning?

CITY MANAGERS	INFRASTRUCTURE MANAGERS	CITY ENGINEERS
ELECTED OFFICIALS	PROJECT PLANNERS	GRANT APPLICANTS
CONSULTANTS	WATER AND WASTEWATER DEPARTMENTS	CITY ADMINISTRATORS
TRANSPORTATION DEPARTMENTS	SOLID WASTE DEPARTMENTS	REGULATORY AGENCIES

## Why Use Value Planning?

Value planning is a tool to help you find more durable, affordable, community-oriented, and operations-friendly solutions to the infrastructure challenges facing your jurisdiction. It applies to any type of infrastructure—water, wastewater, stormwater, transportation, waste, and energy systems.

Think of value planning as a tool to:

- ✓ Build the **right** project.
- ✓ For the **right** reasons.
- ✓ At the **right** time.
- ✓ Using the **right** technology.
- ✓ At the **right** size.
- ✓ At the **right** level of complexity for your community.

Value planning minimizes problems that frequently trouble infrastructure projects, such as cost overruns, schedule delays, dissatisfied stakeholders, and failure to deliver as promised. Other benefits include:

- The ability to save money.
- Reduce capital, operations and maintenance costs.
- Build stakeholder buy-in.
- Increase levels of service.
- Find solutions you can support locally.

## What is in This Guide?

This guide covers the fundamental elements and the process of value planning:

### Fundamental Elements

- Start Early
- Focus on Outcomes
- Include Diverse Perspectives
- Fit the Community

### Value Planning Process

- Listen and Learn
- Define the Right Problem (or opportunity)
- Generate Options
- Choose Best-Fit Solutions

In addition, this guide presents case studies.

## THE BASICS

In this section, you will learn what value planning is, why it's important for successful infrastructure projects, and what benefits it can offer you and your infrastructure project.

### What is Value Planning?

Communities develop projects for many reasons. There may be a problem you need to solve or a goal you want to achieve. These solutions or goals are project outcomes. They can include more effective wastewater treatment, adequate pressure in the drinking water system, streets safe for cars and bicycles, and more green space in your community.

Projects are also associated with costs. The value of a project is a measure of the benefits the project provides compared to the costs. Value accounts for all project costs: construction, operation, project risk, worker safety, staff time, and so on. Value also includes benefits like community good will, worker satisfaction, and positive press.

Value planning is a powerful tool for the early planning of a capital project, before engineering or design work begins. Communities can use value planning as:

- ✓ **A problem-solving tool:** Value planning can help you choose the right project to solve your problem, long before you start designing.
- ✓ **An engagement tool:** Value planning is a group activity that gathers views, knowledge, and insights from diverse parties (engineers, system operators, community). More voices at the table mean more ideas, more ownership of the project, and more buy-in for the chosen solution.
- ✓ **A project development tool:** Value planning prioritizes outcomes for the project. This allows you to focus on value without diluting your project goals.

Value planning is an activity you initiate within your community. While you may bring consultants to join your team, you will conduct value planning for your community. With community input, you can tailor your approach to match local needs, conditions, resources, and constraints.

### What are the Benefits of Value Planning?

Investing in value planning is like buying insurance. You invest time and attention up front to avoid unforeseen costs. Value planning can help avoid or minimize common challenges in planning and constructing infrastructure projects. It can also:

- ✓ Reduce operations and maintenance costs.
- ✓ Increase levels of service.
- ✓ Create projects that address root causes.
- ✓ Develop solutions that are locally supported, operated, and maintained.
- ✓ Achieve desired outcomes with less resource-intensive methods.
- ✓ Generate new opportunities for affordable solutions.
- ✓ Gain stakeholder buy-in from the beginning.
- ✓ Reduce permitting delays.
- ✓ Highlight other benefits for community well-being.
- ✓ Mitigate negative impacts on economic development and the environment.



## When is Value Planning Most Useful?

It is most effective and useful when:

- ✓ Planning starts early.
- ✓ You recognize that the perceived problem may not be the underlying problem.
- ✓ There are differing opinions about the problem and the causes.
- ✓ The project is complex.
- ✓ Several alternatives exist for the solution.
- ✓ Multiple stakeholders invested in the outcome.
- ✓ Risks are high (regulatory, reputational, financial, or legal).

Not every project needs value planning. In fact, value planning may not be cost-effective for your project if several of these characteristics are present:

- ✓ Low cost
- ✓ Low risk
- ✓ Low complexity
- ✓ Routine or familiar project types
- ✓ Well-established solutions
- ✓ Standard technologies
- ✓ Little or no dispute over the solution

These characteristics are guidelines and depend on your community's experience. Use value planning at the right time and for the right reason.



*Welded steel finished water reservoir  
Lake Whatcom Water and Sewer District*

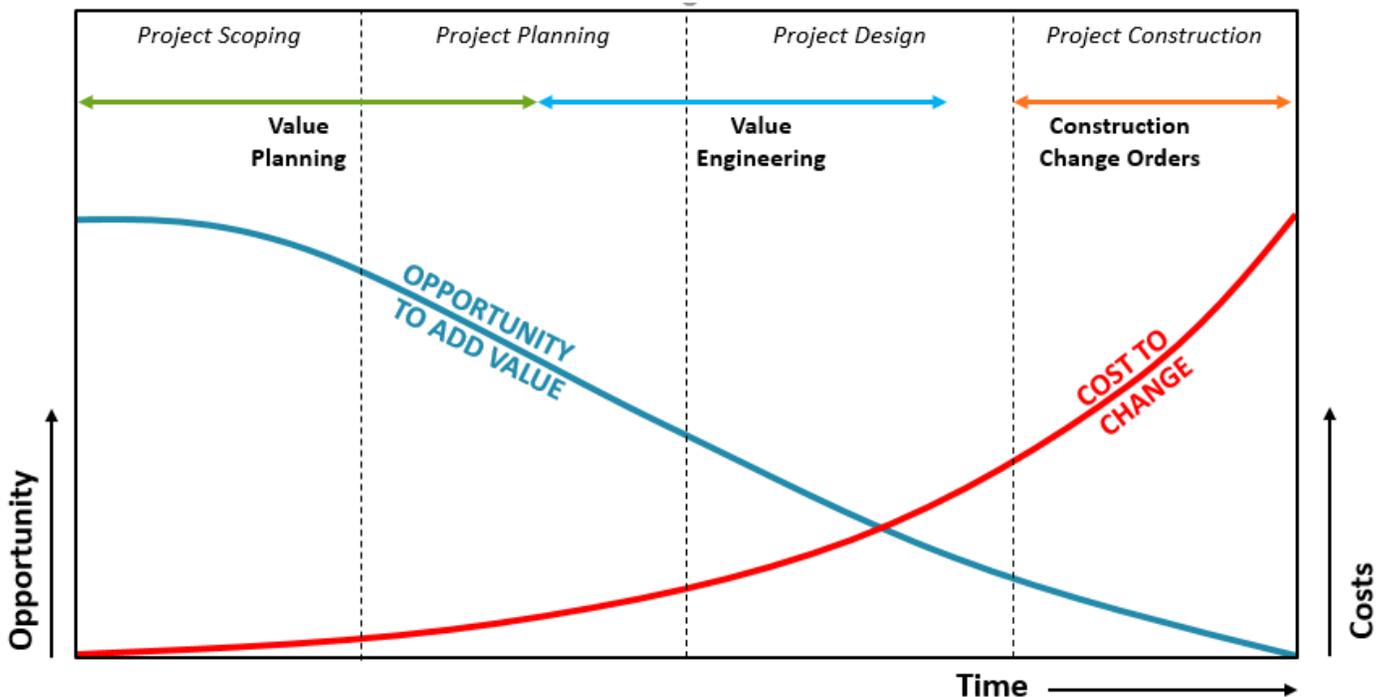
# THE FUNDAMENTAL ELEMENTS

Value planning incorporates fundamental best practices into strategic planning, leadership, project management, critical problem solving, and community development. These fundamental elements are the operating guidelines for a successful planning process.

## Start Early

This figure demonstrates the benefits of early value planning. Early in the process you have many low cost opportunities to use creativity and collaboration to add value to a project. Considering these changes early has low risk and you can always decide not to adopt the change. Implementing changes early will cost less than changes required during construction.

**Figure 1:** The Opportunity to Add Value is Greatest in the Early Stages of Project Development



Value planning works best when you use it to define the project and when you complete it before you begin design.

An asset management program can make your value planning more effective. Managing your assets throughout their life cycle, and periodically assessing their condition identifies emerging problems early and gives you the time necessary for thoughtful planning. Value planning connects to and enhances your asset management plan. In short, asset management helps identify problems, and value planning develops solutions.

Ideally, value planning should be part of existing system planning processes, such as comprehensive planning or water system planning.

### Focus on Outcomes

To encourage smart investments in the right projects, value planning identifies the right problem by focusing on your desired outcomes (not methods or specific solutions) and investigating root causes. An asset management program compliments value planning's focus on project outcomes. The robust data collected as part of your condition assessment moves beyond simple replacement to see the underlying need.



### Include Diverse Perspectives

Infrastructure projects involve a range of stakeholders including city council members, permitting agencies, business owners, and community residents. Value planning engages multiple stakeholders and groups early in the process. Multiple viewpoints lead to more options and better solutions.

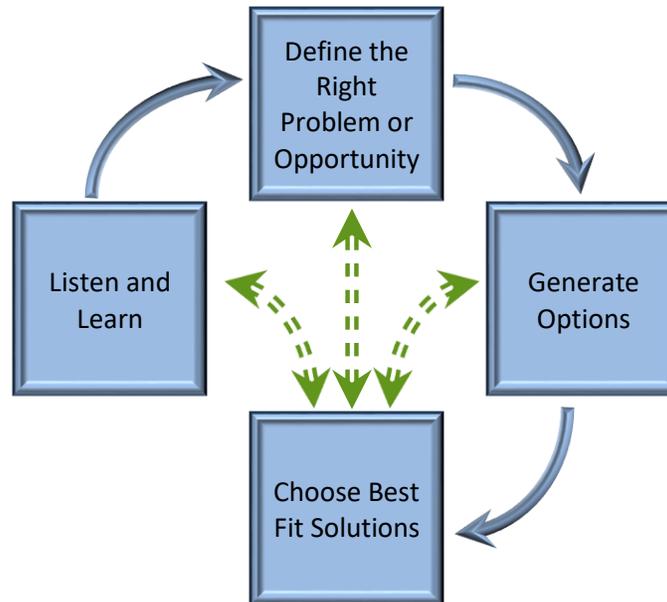
### Fit the Community

Communities are unique with their individual culture, economy, and environment. Value planning promotes solutions that address these unique circumstances. The right project will consider your site-specific conditions, including local staff, technical capacity, financial health, geology, and others.

By developing a project that fits your community, value planning ensures that the community can support the project in the long-term.

## THE PROCESS

In this section, you will learn the process involved in value planning and to apply its principles. A value planning effort requires you to **listen and learn** from the assembled expertise. After listening to a wide variety of stakeholders, you can **define the right problem or opportunity** to address. When you develop and agree on a problem or opportunity statement, you can **generate options**. Once you have a robust set of options to consider, you can **choose best-fit solutions**. Value planning activities align together to create a process for determining the problem and the solution in an inclusive way.



The goal of value planning is to progress from an issue to a solution. Note that the underlying problem you need to solve may be very different from the initial, perceived issue. Value planning is a non-linear process that involves continuously listening to learn, defining the problem or opportunity, and brainstorming while maintaining focus on value. The steps do not have to follow a prescribed order and may be revisited more than once.

The process of moving back and forth between the activities is what ultimately finds your project’s best solution—its rightness. Listening to new perspectives can further define your problem. A creative new idea or alternative leads to a new group of stakeholders. A clear understanding of root causes will generate additional new options. Adapt these activities to the objectives, projects, and stakeholders in your community to create a value planning process that fits your community’s unique needs.

## A Value Planning Story: City of Successville, WA

Successville is a fictional city in Washington with a population of 3,340 people. Key establishments include a large apple packing plant, two restaurants, and one school. Successville's residents are mostly working class, with some low-income housing within the city limits. Successville's water system serves these establishments and the majority of residential customers.

The city's water comes from two wells and one reservoir. Over the past two years, Successville experienced water shortages in July and August.

**John**, the city water manager, is worried. It's March, and John anticipates another water shortage this summer. He wants to be proactive and address this potential issue early. Successville is working on a water system plan update to address the ongoing water shortage. After attending a value planning training sponsored by the Infrastructure Assistance Coordinating Council (IACC), John decides to try it in Successville. He wishes he had heard about value planning two years ago.

In the value planning steps below, let's see how John uses each step to figure out a solution that fits the city's limited financial resources.

### Listen and Learn

John knows that small cities run on relationships, so he sharpens a pencil and begins to write two lists. First, he makes a list of people already working on the water system plan update:

- **Sara**, the city's engineer.
- **Cal**, who maintains the wells and the reservoir.
- **Tom**, the city's consultant, who is working with city staff on the water system plan update.
- **Richard**, the local geologist, who logged the city's wells when they were drilled.

John takes another sheet of paper and lists people who care about the issue:

- **Marvin**, owner of the apple packing plant.
- **Brenda**, who runs the diner.
- **George**, who owns a local restaurant.
- **Monty**, the school principal.
- **Cora**, who works for a nonprofit that advocates for protecting groundwater.
- **Xavier**, a newly elected council member.

John schedules a brainstorming meeting with everyone, with himself as lead.

### Listen and Learn from your Community

The people involved in your project will be the most important element in making the project successful. Involve individuals or organizations your project will affect and people with direct responsibility for completing the project.

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*The people involved will be the most important element in making the project successful*

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This could include the public works director, city manager, city planner, engineers, other technical experts, city staff, construction contractors, elected officials, business owners, regulators, ratepayers, other utilities, funding agencies, or community representatives.

To find the right project for your community, it is critical to actively reach out and engage everyone.

### Decision Makers

Your decision makers are your city council members, board members, or commissioners. These individuals are accountable for your utility and will be responsible for implementing decisions. Listen to your decision makers; they are responsible to residents and community members.

Your elected body will act on your proposed best solution. Any infrastructure project they approve commits the community to a financial obligation. Time spent on early communication and education for decision makers will pay dividends when seeking approval for your project.

### Technical Advisors

Technical advisors bring experience and expertise. Their knowledge and skills will be valuable in defining the problem and identifying solutions. Your technical advisors might include engineers, public works director, scientists, and your operational staff (they know more about your utility than anyone else does).

Technical advisors develop alternatives and recommendations for the decision-making body to consider.

Many communities hire consultants to act as technical advisors who can complement local technical expertise. For your project to be successful, your jurisdiction should in charge of the value planning effort.

### Stakeholders

Stakeholders can be anyone with an interest in the project or anyone the project may affect. Be thoughtful in how you identify, include, inform, and solicit input from stakeholders. Identify stakeholders with various points of view, including those with unconventional or even unpopular perspectives.

To engage stakeholders and gain perspective, you may need to consider different approaches to inform and educate the public about your value planning process. You may consider town hall meetings, neighborhood association meetings, events in the business community, and meetings with other interested groups. Consider alternative locations and times to accommodate other's schedules.

## Define the Right Problem or Opportunity

**John** takes a day to walk around town and visits with individuals on his lists. In each conversation, he learns more about their concerns and their perceptions of the problem. **Marvin** tells him the apple plant is thinking about leaving town, because it can only run half the packing lines during summer water restrictions. From **Brenda** and **George**, he discovers that they have to buy bottled water for their customers, which is an added cost for their low-margin businesses. **Monty** complains that the school grounds look awful because the playing fields aren't getting enough irrigation. **Cora's** nonprofit is very busy helping homeowners conserve water during the water restrictions. **Xavier** is getting an earful from residents who want green lawns and gardens in the summer. Rental properties have also come down in value because of the water restrictions.

"I need more data," John says to himself. He asks **Tom** to collect and analyze water-use data during July and August. Tom writes up his findings, which show that the two wells and the reservoir are unable to meet all summer-time peak demands, even after the school modifies its irrigation system. The aquifer is declining and one of the wells will most likely become inoperable, because it's too shallow to tap the receding water table.

"Well, that puts a whole new spin on things," says John to Tom. "Before, I thought our problem was not having enough wells. However, this problem is much bigger. We can't solve it by just drilling a few new wells. The real problem we need to solve is to meet our city's demand for water reliably." At the next city council meeting, John explains this new understanding to the residents and council members.

Building the right project for the right reasons means identifying the underlying problem or opportunity. You should define the right problem before you make any decisions about the project type, design, budget, or construction. Your written statement will serve as an anchor for managing the project.

The perceived issue is often not the underlying problem. To ensure you are on the right track, you may need more information so that you can understand the problem from many different angles. Focus on finding the root cause of the problems you identify.

The process of defining the right problem creates opportunities to question assumptions and gain insights to solve the problem efficiently. It also develops a shared understanding with your stakeholders.

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*Defining the right problem is  
the key to success*

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Defining the right problem sets you up for success when generating alternative solutions. Asset management can lend a supporting framework in choosing between alternatives and prioritizing investments.

## Generate Alternative Solutions

As John leaves the council meeting, he reflects how far he’s come in just a few weeks. “The council agreed on the definition of the problem. Everyone knows what we’re aiming for!”

The next morning, John makes a call: “**Tom**, we need to get creative here. We don’t have a ton of resources, so we need all the good ideas we can get.” Tom suggests a field trip to Sparkman, a town that faced a similar water challenge five years ago. John learns about Sparkman’s water conservation measures for industrial and residential users and how they fixed leaky pipes causing inordinate water losses. “We could do that.”

Back in Successville, John calls a two-hour brainstorming meeting. For an outside stimulus, he asks Sparkman’s city engineer to take part. John is surprised how quickly the group generates possible solutions. Among them are ideas to rehabilitate the existing well, rainwater capture, build an intertie to a nearby water system, water reclamation, fix leaky pipes, and develop a water conservation plan.

“It was worthwhile to look beyond our city boundaries,” says John. “Otherwise, we might not have the intertie or water reclamation on our list of alternatives.”

By listening to your stakeholders and defining the problem, you set the stage for generating alternative solutions. Considering a large number of options opens the door to finding the right project for your community. The goal of value planning is to generate more options than conventional planning methods. Creative ideas generated during brainstorming may help you identify new stakeholders and the need for more listening and learning.

One alternative you should consider is doing nothing. The “no action” alternative invites everyone to share his or her ideas and solutions. Even the most “out there” idea is probably better than doing nothing. A “no action” alternative is also a good way to understand the consequences of maintaining the status quo.

Like any brainstorming process, all ideas are worth listening to. Try to identify positive elements or workable parts to every idea. Use ideas from others as a springboard for your creativity.

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*“The best way to have a good idea is to have lots of ideas.” Linus Pauling*

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Not all alternatives need to involve new infrastructure. Rehabilitating or refurbishing existing infrastructure is an option worth considering. By considering simple fixes, such as process adjustments or training, you open the door to additional creativity.

## Choose Best-fit Solutions

After their brainstorming session, John needs to narrow down the list of ideas to a workable solution for the city.

Many of the ideas generated sounded interesting during brainstorming but are not practical or will not actually solve the city's water supply problem. John and his staff quickly eliminate ideas that will not solve the problem, some ideas because of legal limitations, and ideas that would take too long to implement.

John and his technical experts calculate cost estimates for the ideas that have technical merit. Tom, the city's consultant, develops a preliminary scope of work for each idea, creates a cost estimate for construction, and another cost estimate for long-term operation. Tom also identifies the benefits of each idea and how much of the problem they would address. By evaluating the life-cycle costs and benefits each alternative provides, John can choose the best-fit solution.

In the end, the best option is a combination of six ideas: rehabilitate the existing well; drill a new, deeper well; intertie with a nearby water system; reduce water use at the apple packing plant; implement residential water conservation measures; and fix leaky pipes. "That's a longer-lasting, more resilient approach than just drilling a well," muses John.

A week later, John presents the team's recommendations to Successville's city council and residents. Because John included the council in the process from the beginning, they grant approval for the infrastructure fixes and immediately begin work on water conservation measures for customers. With this decision made, the city council asks **Cal**, the water system operator, to fix leaks in the water system. **Tom**, the consultant, is asked to develop preliminary costs on rehabilitating the existing well, drilling a new well, and installing an intertie with the adjacent town. **Tom** includes these in the water system plan update. In addition, **Marvin** agrees to hire a process engineer to help his apple processing plant reduce water use.

Your team is now at the final phase in value planning. At this point, you have developed an outcome-focused problem statement, and you have generated a wide range of ideas, concepts, and possible solutions. Now you will choose one or more ideas as your best-fit solution to solve the problem.

**Screen Solutions for Their Ability to Solve the Problem You Defined.** Compare all your solutions against the team's problem statement. If an idea does not address the problem statement, remove it from further consideration. Similarly, if an idea is not feasible, remove it from consideration.

There may be many reasons why an idea is not feasible. Here are a few examples:

- Cannot meet regulatory requirements.
- Legal limitations, property acquisition or access.
- The idea does not meet your time line.

**Develop a preliminary project plan for each remaining idea.** A project plan includes a conceptual design, a capital cost estimate, and an annual O&M cost estimate. You may need help from engineers, cost estimation tools, or your asset management planning process. Your conceptual design needs enough detail to develop comparable cost estimates. No matter what method you use to estimate cost, it must be quantifiable and objective.

**Evaluate Alternatives.** Depending on the complexity of the problem and the ideas generated, calculating the value for each solution can be complicated. To evaluate each preliminary project plan, you need to consider:

- Capital and O&M costs
- Extent of problem solved
- Other benefits
- Life cycle costs
- Potential project risks
- Effort to implement

When evaluating alternatives, remember the solution has to fit your community. Consider your ratepayers and your staff. Reflect on how well the proposed technology fits your community.

You may need to put all this information into a table to visualize the benefits, risks, and costs. (See Appendix A for an example) Consider all the costs associated with each alternative. Policy, personality, politics, public perception, and adopting rate increases all have real costs that you should consider. When you compare alternatives, be mindful and compare “apples to apples.”

An idea with multiple benefits can add value to your project. For example, using bio-swales and rain gardens to manage stormwater in a neighborhood simultaneously solves a flooding issue, cuts storm flows to the treatment plant, treats stormwater runoff, creates wildlife habitat, and beautifies the neighborhood.

**Choose the Best-Fit Solution.** The idea that solves your problem and provides the greatest value is your best-fit solution. However, not all solutions will provide the same benefits; some may only solve part of the problem. That does not mean those ideas failed. Instead, they are part of an incremental solution. In this case, you might end up choosing more than one alternative.

Value planning incorporates the rightness factors. The best-fit solution should be the **right** project, for the **right** reasons, at the **right** time, using the **right** technology, at the **right** size, at the **right** level of complexity for your community.

### Satisfaction for the City of Successville

A year later, John sips coffee at his desk and heaves a sigh of relief. “We’re all set for this summer,” he smiles to himself. “We kept the apple processor in town, and this year the kids will play on green fields when they come back to school. We’re not using as much water as we used to, even though our city is growing.”

Just then, the phone rings. It’s Louise, the mayor of Paysonville. “Hey, John,” says Louise, “I have a problem with our local stormwater system, and I want to try value planning. Can you tell me how it worked for you?”

John laughs aloud. “With pleasure, Louise! I was a bit skeptical at first, but I’m glad we used it for our water shortage issue. Value planning really paid off. By involving stakeholders and spending time to generate more options, we found affordable and long-term solutions for our city. By the way, you should look up the Introductory Value Planning Guide. It really helped me do value planning at the right scale for our city and our project. You can find it on the IACC website.”

*New Transmission Main, City of Spokane*



## CASE STUDIES

### Eastside Liberty Lake Improvement Club

#### *Right Project – By Chance*

The saying goes that hindsight is 20/20, and that was the case for the Eastside Liberty Lake Improvement Club (the Club), a water system with 325 customers. They found the right solution by happy coincidence. In retrospect, value planning would have left less to chance, sped up the process, and saved resources spent pursuing a less favorable option. Here’s what happened:

In 2015, the Club borrowed \$905,465 from the Drinking Water State Revolving Fund (DWSRF) to improve its wells and pumping station. The loan had a 1 percent loan origination fee, 1.5 percent interest rate, and no principal forgiveness.

In 2016, recognizing that the Liberty Lake Sewer and Water District (District) had adequate pumping capacity to serve the Club, the District general manager contacted the DWSRF Program to find out whether the Club and the District could consolidate and have the loan reassigned to the District. This made sense.

1. The District was familiar with the Club’s system through operation and maintenance service contracts, including meter reading and water system billing.
2. The Club had grown to 325 customers and was struggling to make needed water system improvements and maintain adequate pressures to all customers. In contrast, the District had capacity to provide water and adequate staff to oversee the Club.
3. DWSRF loan terms for consolidation projects are more favorable. They allow up to 50 percent principal forgiveness, reduce interest rates from 1.5 percent to 1 percent, and reimburse the loan origination fee.



*New pipeline construction at the Club*

The revised project scope included a second intertie between the two water systems, abandoned the Club’s existing groundwater sources and pump stations, and improved the Club’s distribution system by replacing old and undersized water mains. At a public meeting, the District presented all the information to customers and the Club’s members approved the consolidation proposal. As a result, the Club’s base water rates dropped from \$50.76 to \$18.52 per month.

#### LESSONS LEARNED

In this scenario, value planning would have identified the consolidation project in the “generating alternatives” step, before the Club submitted its loan application. In actuality, the District general manager’s inquiry led to discovery of the right project. A happy outcome, but why leave something so important to chance?

## Fones Road Congestion Relief

### *Complexity Defies Conventional Solutions*

The City of Olympia Transportation Department faced the tough challenge of reducing congestion along Fones Road, a 0.64-mile arterial connecting Interstate 5 to southeast Olympia. The project became urgent when population growth significantly degraded levels of service for commuters, commercial drivers, businesses, and residents. The city wanted to incorporate multi-modal solutions into the project. The project’s complexity made it a perfect candidate for value planning.

In 2017, the city conducted a value-planning workshop. To include diverse perspectives, the city selected participants from its Transportation, Parks, and Water departments. It also invited stakeholders from an economic development agency, a community transit organization, and a regional planning council. In all, 23 people took part. The city brought in a facilitator and technical experts to help.

Instead of asking, “How can we relieve congestion?” the team raised a more compelling question: **“How can Fones Road showcase multi-modal solutions and relieve congestion while raising quality of life in the area, at or below the cost of a conventional road-widening solution?”**

During a half-day field trip and a daylong workshop, this diverse group questioned assumptions, generated hundreds of alternatives, defined value metrics, and evaluated and refined the best solution sets. At the end of the day, three promising solution concepts had taken shape. Consultants further developed and evaluated the concepts after the workshop.



*Refining Concepts at the Value Planning Workshop*

The team found that only half of Fones Road needed significant road widening. Coupled with a traffic circle, sidewalk improvements, and bicycle lanes, the new design concept would increase walkability, connect the residential area to the retail area, and give access to a regional bike trail—for less cost. In addition, value planning identified future projects to help accommodate future growth in the area.

### LESSONS LEARNED

The Public Works director was fully committed to the value planning process. He was instrumental in providing funding and convening staff and stakeholders. The field trip—in heavy rain—gave workshop participants a direct sensory experience of the project’s opportunities and constraints. That experience enriched discussions on the following day. The diversity of perspectives among the participants generated unexpected alternatives, contributing to the success of the workshop and the project.

## Town of Harrah Submerged Aerated Rock Filter

### *Fit for Community Ensures Project Success*

Harrah, a 640-person community in the Yakama Indian Reservation, operates a wastewater utility within city limits. In 2012, EPA issued an NPDES permit for effluent nitrogen limits of 1.82 mg/l (winter) and 1.93 mg/l (summer). The town's three-cell aerated lagoon system was unable to meet these limits, especially in cold winter months when biological growth declines. With the regulatory deadline looming, the town interviewed engineering firms with experience solving similar problems for small communities.

The “business as usual” solution for removing nitrogen is mechanically activated sludge treatment. However, that treatment is an expensive capital project that would require the town to hire operating staff with advanced certification. Instead, the town wanted a solution proven to function in a cold climate that was simple enough to operate with existing staff.

Town staff worked hard to include residents in the process. For example, it held several well-attended community forums where residents could discuss the need for the project and the effects they might experience. In addition, Mayor Harrer took an active role in decision making and communicating with her constituents. USDA staff described Harrer as “someone who really cares about her town and the people there.”

The town considered several alternatives: land application, summer-only discharge, mechanical secondary treatment, a submerged aerated rock filter, and several proprietary technologies for lagoon modification.

Based on their desired outcomes, the town chose the submerged aerated rock filter as its best-fit solution. Although rarely used in Washington, this technology has a well-established performance record in cold-winter regions, such as the Midwest and Canada. Construction and operation is inexpensive and simple: the belowground rock filter receives lagoon effluent; the aeration headers are located beneath 8 feet of river rock, and 2 feet of woodchips and mulch cover the whole system for insulation. USDA Rural Development provided the funding for the project.

As an unexpected benefit, the rock filter produced an effluent clear enough to make UV disinfection possible. Compared to the town's existing chlorination and dechlorination system, UV disinfection operates more easily, practically eliminates chemical costs, and removes a worker safety concern. By happy coincidence, the nearby Town of Moxee had decommissioned its UV disinfection system 5 years prior. Harrah was able to procure the nearly new equipment and install it for less than the cost of a new system. Best of all, the new aerated rock filter performed admirably. In the first month, nitrogen was below the detection limit in most samples.

### LESSONS LEARNED

The Town of Harrah clearly defined its desired outcomes. The project team chose the right engineering firm to ensure solutions would fit the community. Town leaders, including the mayor, engaged citizens to understand the project, discuss outcomes, and review alternatives. The town also looked outside the state for proven treatment technologies in cold weather regions. Finally, the chosen solution offered a valuable secondary benefit—allowing UV disinfection.

# APPENDIX A

## City of Successville Water System

<b>People involved:</b> City water manager, city engineer, maintenance personnel, consultant, geologist, owners of local businesses, school principal, local nonprofit organization, and city council. Experts from nearby towns who have had a similar issue.														
<b>Community feedback:</b> Apple plant is looking at leaving town due to summer water shortages reducing their production by half. Local eateries have to buy bottled water for customers which adds cost. The school fields aren't getting enough irrigation. The nonprofit is helping residential customers conserve water. The city council is getting negative feedback from the community about the water restrictions.														
<b>Expert feedback:</b> The two wells and reservoir are unable to meet summer-time peak demands. The school modifying its irrigation system does not fix this issue. The aquifer is declining and one of the wells will probably become inoperable.														
<b>Perceived problem(s):</b> Not having enough wells.														
<b>Actual problem:</b> Needing to develop a system to meet the city's demand for water reliably.														
<b>Brainstormed solutions:</b> Rehabilitate the existing well, rainwater capture, build an intertie, water reclamation, fix leaky pipes, and develop a water conservation plan.														
Project Description	Capital Cost	Annual O&M Cost	Life Cycle	Addresses Problem?	Risk			Effort to Implement			Cost			Notes
Rehabilitate Well	\$168,000	\$36,000		Yes	✘	M	H	✘	M	H	✘	M	H	Increase reliability and functionality
Drill New Well	\$561,000	\$36,000		Yes	✘	M	H	✘	M	H	L	✘	H	Increase system input
Build an Intertie	\$371,000			Yes	✘	M	H	L	✘	H	✘	M	H	Increase availability at peak times
Rainwater Capture				No	L	M	H	L	M	H	L	M	H	
Water Reclamation				Yes	L	M	H	L	M	H	L	M	H	
Fix Leaky Pipes				Yes	L	M	H	L	M	H	L	M	H	
Water Conservation Plan				Yes	L	M	H	L	M	H	L	M	H	

# APPENDIX B

## Project Title

<b>People involved:</b>														
<b>Community feedback:</b>														
<b>Expert feedback:</b>														
<b>Perceived problem(s):</b>														
<b>Actual problem:</b>														
<b>Brainstormed solutions:</b>														
Project Description	Capital Cost	Annual O&M Cost	Life Cycle	Addresses Problem?	Risk			Effort to Implement			Cost			Notes
				Yes	L	M	H	L	M	H	L	M	H	
				Yes	L	M	H	L	M	H	L	M	H	
				Yes	L	M	H	L	M	H	L	M	H	
				Yes	L	M	H	L	M	H	L	M	H	
				Yes	L	M	H	L	M	H	L	M	H	
				Yes	L	M	H	L	M	H	L	M	H	